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Great Lakes Update

Frequently Asked Questions

This quarterly issue of the Great Lakes Update has been compiled to include a number of frequently asked questions that have arisen due to rising Great Lakes water levels and it contains the best available answers to these concerns. If there are further questions, please contact us by mail, phone, or email at the addresses at the conclusion of this article.

Current Conditions

Why are water levels in the Great Lakes so high?

Higher than average precipitation (rain and snow) on the Great Lakes basin during late 1995, throughout 1996, and through May 1997 has been the primary cause for the current high Great Lakes water levels. Lower rates of evaporation during this period have also contributed significantly.

The 1995-1996 winter brought heavier than normal snowfall across much of the Great Lakes. Precipitation over the entire basin for 1996 was 113% of average, the fifth highest year since 1900. Basin by basin, Lake Superior received 121%, Lakes Michigan-Huron 107%, Lake Erie 117% and Lake Ontario 118% of their yearly averages during 1996. The winter of 1996-97 again brought extremely heavy snowfalls to the northern parts of the basin, with some regions setting record high snowfalls. On average, the Lake Superior basin snowpack was nearly 155% of its normal conditions. During the first half of 1997, higher than average precipitation continued over much of the lakes and their drainage basins.

How much have the Great Lakes risen and how do they compare with all-time high records?

At the beginning of 1996, Lake Superior was slightly below its long-term average, and the other Great Lakes were slightly above their long-term averages. Each of the Great Lakes have risen significantly since then.

Since January 1996, Lake Superior rose about 13" and is now about 4" below its record high set in 1986 for June. Lakes Michigan-Huron rose about 30" to its present level, now being about 7" below its June record high set in 1986. Over the same last 17 months, Lake St. Clair rose about 38" and is now about 6" below its record high set in 1986. Lake Erie rose about 36" and is now about 4" below its record high set in 1986. Lake Ontario rose nearly 26" over the same period and is now about 18" below its 1952 record high.

What impacts do high water levels have?

High levels can cause flooding and expose some structures to wave attack. They also can increase short-term erosion, though they do not appear to affect long-term erosion rates.

How much flooding do you expect this year?

Nobody knows. Though flooding and other adverse effects are highly probable this year, damage extent will depend on a number of factors, these being: 1) supplies - the lakes may rise beyond their normal seasonal rises depending on continued high precipitation and low evaporation; 2) storms - wind-driven waves can contribute to flooding and erosion; and, 3) wind set-up - strong, steady winds can cause levels on one side of the lake to rise significantly for a few hours or days.

Why can't extreme high water levels be prevented?

Water levels fluctuate because climatic influences fluctuate. These outweigh the human influences on water levels. The level of each lake is determined by its water supply and its outflow capacity. Precipitation, the major factor determining the water supply to the Great Lakes, cannot be controlled. Evaporation from the lakes also exerts a significant influence that usually follows precipitation trends. When precipitation is higher, there are usually more clouds and less evaporation.

Shoreline Erosion

Do higher water levels cause shoreline erosion?

When water levels are high, wind-driven waves can trigger significant short-term erosion events that would otherwise occur later or more gradually. However, long-term erosion rates appear to be independent from water level fluctuations for most of the Great Lakes shoreline.

The major factors affecting long-term erosion rates are wave energy, wave direction and long-term patterns of sand and sediment transport along the shore. Bluff stability, surface and groundwater flow, and freeze-thaw cycles also play a role in bluff recession. None of these factors appear to be directly related to water levels fluctuations. The lake level does, however, have an effect on where wave energy is dissipated on the beach profile, and thus may affect shore erosion and bluff recession rates over short time periods.

Why do bluff collapses increase when lake levels are high?

Bluff recession, or the landward movement of the bluff crest, is the most visible aspect of coastal erosion and receives the most attention. However, bluff recession is just one indicator of erosion forces, and can mislead observers because of the length of time, or lag, that usually occurs between beach erosion and bluff recession. Coastal erosion occurs over an area roughly from the top of the bluff offshore to a depth of 30 feet of water depth. Erosion originating offshore often does not become apparent as bluff recession until days, weeks, months or even years have passed.

Bluff recession also does not occur at a constant rate, but may vary considerably over relatively short time periods of days, weeks, and months. It is very common for a reach of coastline to have no bluff recession for months or years and then experience severe recession over a period of days or weeks. Bluff recession is often the result of events that may have occurred months before, or gradually over a period of years. This makes it difficult to link bluff recession with the forces or influences that are directly responsible.

What about storms and beach erosion?

The most dramatic erosion often occurs as a result of storms, partially because the highest energy waves are generated under storm conditions. Added to this, storms often produce short term shifts in lake levels as water is pushed from one side of a lake to the other. The effect of storms is also influenced by their duration and frequency of occurrences.

Water Level Controls

Where are the major control points for water levels and flows in the Great Lakes basin?

Limited water level control is achieved by regulating the outflows from Lakes Superior and Ontario, in accordance with the International Joint Commission (IJC) Orders of Approval for each lake. The outflows from the other Great Lakes depend exclusively on their levels.

Regulating the outflow from Lake Superior affects the level of Lake Superior, Lakes Michigan-Huron, and to a lesser extent, Lake Erie. Lakes Michigan and Huron are considered as a single lake since they are connected by the wide and deep Straits of Mackinaw and thus remain at the same level.

Regulating the outflow from Lake Ontario affects levels on the lake and on St. Lawrence River from the Thousand Islands to Montreal. It has no effect on levels on the upper lakes since Lake Ontario is separated from them by the Niagara Falls.

Lake Superior Regulation

What are the goals of Lake Superior regulation?

The essence of the IJC's Orders of Approval for Lake Superior is that the outflow shall be regulated to keep the level of Lake Superior in balance with the level of Lakes Michigan-Huron. This means that supplies will be distributed so that one lake is not higher or lower in its range than the other lakes. The Orders of Approval state that regulation shall not increase the risk that Lake Superior would exceed elevation 603.2 feet (IGLD, 1985). The IJC's International Lake Superior Board of Control has developed a regulation plan to ensure that the outflow meets these objectives.

The control works in the St. Marys River can hold water on Lake Superior or release it to Lakes Michigan-Huron, but cannot remove it from the Great Lakes system.

Could the flow out of Lake Superior be reduced to lower levels on Lakes Michigan-Huron?

Yes, it is possible to reduce the Lake Superior outflow, but this will raise the Lake Superior level, which is already high.

Could the outflow from Lake Superior be increased to lower the water level on Lake Superior?

Yes, it is possible to increase the Lake Superior outflow, but this would raise the Lakes Michigan-Huron level, which is already high.

Lake Ontario Regulation

What are the goals of Lake Ontario regulation?

Essentially, the IJC's Orders of Approval establish a four-foot target range for water levels on Lake Ontario and provide protection for navigation, hydropower downstream in Quebec and communities along the St. Lawrence River from the Thousand Islands to past Montreal. This range (from 242.3-246.3 feet (IGLD, 1985)) is maintained whenever water supplies are within those experienced prior to 1954. When water supplies are more extreme, criterion (k) of the IJC's Orders provides all possible relief to shoreline communities on Lake Ontario and the St. Lawrence River.

The IJC has granted limited discretionary authority to their St. Lawrence River Board of Control to enable it to temporarily set flows different from regulation plan flows when this can be done to assist one or more interests without causing undue harm to others. Discretionary authority has been used on occasion to assist communities on Lake Ontario and the St. Lawrence River, commercial navigation, recreational boating, hydropower and municipal water supply and to provide enough water for critical habitat when fish are spawning.

How does regulation of St. Lawrence River flows affect water levels on Lake Ontario?

Regulation has reduced the occurrence of extreme high and low water levels on Lake Ontario. For example, Lake Ontario is presently about 2.3 feet lower than it would have been if the project and regulation had never been put into place. The excavation in the St. Lawrence River that occurred when the hydropower project and seaway were constructed has made higher outflows possible when high water supplies occur.

Although regulation has brought substantial benefits to Lake Ontario, some shoreline residents are skeptical. They have experienced higher levels since regulation began in 1960 because this period has been cooler and wetter than any other period since 1900. More water has been flowing through the Great Lakes since 1960 and these higher supplies would have produced much higher levels on Lake Ontario without the project and regulation. Though Lake Ontario receives all of the outflow from the other Great Lakes, it was the only Great Lake that did not set record high water levels in 1985-86.

Why was no action taken to increase Lake Ontario outflows in fall 1996?

Action was taken in a timely manner in fall 1996 when precipitation over the Lake Ontario basin increased. In September, the Board of Control adopted the policy to increase Lake Ontario outflows above the regulation plan when this could be accomplished without causing undue harm to other interests. Flow reductions were frequently needed, however, to keep water levels in the navigation channel just above Long Sault Dam from going below chart datum. Chart datum is a critical depth below which adverse impacts would occur to commercial navigation. From October through December 1996, the average weekly level at Long Sault Dam was at or within an inch of chart datum for nine out of 14 weeks. Despite this critical situation, the Board of Control was able to achieve outflows greater than the regulation plan called for during 10 of the 14 weeks.

What is "criterion (k)" and why did the Commission wait until January 1997 to invoke it?

Criterion (k) gives the Board of Control additional authority to provide further relief to communities on Lake Ontario and the St. Lawrence River by setting alternative outflows. Criterion (k) is an extraordinary provision of the Orders of Approval, which the IJC may invoke when water supplies to Lake Ontario are more extreme than those that had been experienced prior to 1954. These supply conditions did not exist until January 1997. Under criterion (k), record outflows for this time of year were set in February and March 1997.

Diversions

What are the diversions and how much do they affect Great Lakes water levels?

The major diversions in the Great Lakes basin that affect water levels to a measurable extent are: (1) diversions into Lake Superior at Long Lac and Ogoki; (2) a diversion out of Lake Michigan at Chicago; and, (3) a diversion between Lakes Erie and Ontario through the Welland Canal. These diversions have a minor effect on water levels compared to natural factors and regulation of Lakes Superior and Ontario.

The present flow rates into Lake Superior from the Long Lac and Ogoki diversions average 150 cubic meters per second (cms) (or 5,300 cubic feet per second (cfs)), the flow out of Lake Michigan at Chicago is 91 cms (3,200 cfs) and the flow from Lake Erie to Lake Ontario through the Welland Canal is 221 cms (7,800 cfs). This compares to the average outflow of 2,210 cms (78,000 cfs) from Lake Superior and 7,000 cms (247,000 cfs) from Lake Ontario.

The combined effect of these three diversions has been to permanently raise Lake Superior by an average of 2.1 centimeters (.8 inch), lower Lakes Michigan-Huron by .6 centimeters (.2 inches), lower Lake Erie by 10 centimeters (4 inches) and raise Lake Ontario by 2.4 centimeters (1 inch).

Could the flow in the Long Lac and Ogoki diversions into Lake Superior be reduced?

Under extraordinary circumstances, Canada has agreed to reduce or shut off Long Lac and Ogoki inflows in the past.

These diversions are entirely in the Province of Ontario and were authorized between the U.S. and Canada in 1940. Although the diversions are under Canadian control, there has been consultation and cooperation between the two Governments on these diversions during emergency periods. Examples of mutual cooperation occurred in 1952, 1973 and 1985 when, in response to a request by the U.S., Canada reduced both diversions to help to alleviate problems created by high lake levels. Difficulties with reducing the diversions may occur when high water levels are also occurring in the Albany River watershed, where the waters of Long Lac and Ogoki would otherwise drain.

Could the outflow be increased from the Lake Michigan Diversion at Chicago?

The Lake Michigan Diversion at Chicago has the physical capacity to flow up to 283 cms (10,000 cfs), though flooding and impacts to navigation would occur at this flow rate. However, there is no precedent for using the diversion to help to alleviate high water on the Great Lakes. The diversion has been the subject of legal actions by Great Lakes states throughout the century to limit the amount of water being diverted. The dispute reached the U.S. Supreme Court, whose 1980 decree sets the flow rate at 3,200 cfs. Proposals have occasionally been made in the U.S. Congress to increase the amount of the Chicago diversion, but none of the proposals have been successful. Canada has objected to any proposed unilateral action by the United States to increase the flow.

More recently, Great Lakes states have objected that the control works are leaking and that the actual flow rate is more than allowed. In October 1996, the eight Great Lakes Governors and the Federal Government signed a formal agreement that commits the Corps of Engineers to make repairs and confirm the flow limitation at 3,200 cfs.

Could the flow at the Welland Canal be increased to get more water off of Lake Erie?

If the canal was used solely to lower Lake Erie and all navigation was stopped, flows could possibly reach 340 cms (12,000 cfs). Damage to the banks of the canal would occur at this flow rate. Flows in the 1980s were at 260 cms (9,200 cfs), but were reduced to facilitate repairs on a lock wall that failed in 1985 and to facilitate a long-term rehabilitation program. The present flow is 221 cms (7,800 cfs).

Lake Erie Outflows

Are the levels of Lake Erie regulated?

No, the level of Lake Erie is not regulated. Mathematical modeling and field measurements taken in June 1987 suggest that there could be a slight backwater effect from the operation of the Chippewa-Grass Island Pool that could affect the outflow from Lake Erie. However, it has not been possible to measure the effect on Lake Erie outflows while changing the level of the Chippewa-Grass Island Pool because the effect is smaller than flow changes caused by shifts in the wind and other background phenomena. The Chippewa-Grass Island Pool is located in the Niagara River above Niagara Falls at the intakes of the hydropower projects. Its level is regulated by an 18-gate control structure, but regulation of flows through this structure does not set the outflow from Lake Erie.

Has construction in the Niagara River affected the outflows from Lake Erie?

Artificial obstructions and fills have been placed in the Niagara River since 1820. These include the Peace Bridge, International Railway Bridge, the City of Buffalo water intakes, the Bird Island Pier, Mather Park (Niagara Parks Commission) and smaller fills on both sides of the river. The cumulative effect of these obstructions has been to raise the level of Lake Erie between 0.12 and 0.16 meters (4.8 and 6.3 inches), according to the 1993 IJC Levels Reference Study Board report.

The IJC has recommended that the Governments enact measures to insure that further encroachments do not occur in the Great Lakes connecting channels, including the Niagara River. The IJC has suggested that removal or modification of some of the existing obstructions, particularly those in the vicinity of the Peace Bridge, should be considered.

Emergency Measures

What short-term emergency measures are available to lower high levels and how much relief can they provide?

Existing physical facilities could be used to reduce the Long Lac and Ogoki diversions, store water on Lake Superior, increase the Chicago diversion, increase the flow through the Welland Canal, flow water through Black Rock Lock in the Niagara River and lower the Chippewa-Grass Island Pool in the Niagara River. These actions could be taken with relatively little capital investment at existing facilities. These measures will provide minor relief in parts of the system, but would result in major adverse consequences in other parts.

A 1988 IJC report calculated the maximum effect that would be physically possible by taking emergency action at all existing facilities. After two years of operation, water levels would change by approximately the amounts following, compared to the levels that would have occurred if the actions had not been taken: Lake Superior would be raised 40 centimeters (16 inches); Lakes Michigan-Huron would be lowered 34 centimeters (13 inches); Lake Erie would be lowered 27 centimeters (11 inches); and, Lake Ontario would be lowered 40 centimeters (16 inches).

These are the approximate effects that would result after two years if all of the following emergency measures are taken (flows are in cubic meters per second (cms) and cubic feet per second (cfs)): Lake Superior - establish emergency discretion to raise Lake Superior storage to 604.2 (IGLD, 1985), up to one foot above its current maximum elevation; Long Lac / Ogoki Diversions - decrease flows to zero; Chicago Diversion - increase flows to 283 cms (10,000 cfs); Welland Canal - increase flows to 310 cms (11,000 cfs); Black Rock Lock - increase Lake Erie outflow by 36 cms (1,300 cfs); Chippewa-Grass Pool - increase Lake Erie outflow by 84 cms (3,000 cfs).

Other combinations of these measures could provide less relief and fewer adverse effects. Reaching agreement to implement any of these measures is complicated by the fact that different jurisdictions control the physical facilities and, as noted, all of the actions transfer adverse effects from one location to another.

What decisions are needed in order to open the Black Rock Lock to remove additional water from Lake Erie?

At the very least, consultations between the U.S. and Canadian Governments would be needed before the Black Rock Lock could be used as an emergency water control structure because of the impact the additional flows would have on Lake Ontario and the St. Lawrence River. Under the Boundary Waters Treaty, an application to the IJC or an agreement between the two Governments would be required.

The IJC's 1988 report on short-term emergency measures, including the Black Rock Lock, recommended that the two Governments develop coordinated, emergency management plans for both high and low conditions in the Great Lakes.

Management and Public Involvement

Why is there no single agency that can make decisions on matters that affect Great Lakes water levels?

Historically, sovereign nations have not been willing to cede this degree of authority to international control. The Great Lakes basin includes two countries, eight states, and two provinces. Mechanisms exist to coordinate actions among agencies in these jurisdictions, however, there is not one entity with the authority over all facilities that affect levels.

Long Term Solutions

Why not siphon off some of the water and send it to areas that need it?

The financing and political support that would be needed to undertake a major new diversion do not exist at present.

There are a number of objections that usually surface when this possibility is discussed. No economic use for the water exists that could support the cost of moving enough of it out of the basin to appreciably lower the Great Lakes. Such a diversion would also likely increase flooding on any of the nearby waterways that could be used to transport the water. Those who might need it, particularly in wet periods such as the present, are far from the Great Lakes basin. Finally, if such a diversion were established, it might be difficult to shut off during years of low water supplies in the Great Lakes basin.

What long-term solution should be put in place to eliminate the harm that comes from fluctuating water levels?

In several major studies over the years, the IJC has concluded that building new structures to further regulate water levels is not economically justified. Further regulation would be costly and would have negative impacts on hydropower production, navigation, the environment and other interests. In addition, it would do nothing to insure that new development, which continues on the shoreline, is carried out in a way that does not put more people and investment at risk from flooding and other adverse consequences.

After seven years of intense study, the most recent IJC report recommended a range of actions in 1993. One central recommendation is that the Governments aggressively promote the use of shoreline land-use management as the principal component of a strategy to alleviate the adverse consequences of fluctuating water levels.

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